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Testing Weapons in Space

Would a more permissive weapon-testing regime than is set forth in the Antiballistic-Missile Treaty be in the U.S. interest? Reviewing the rationale of the treaty's provisions helps to answer the question

by Ashton B. Carter

When the U.S. and the U.S.S.R. were working out an agreement to restrict antiballistic-missile (ABM) systems in the late 1960's and early 1970's, American negotiators recognized that a treaty merely banning the deployment of a nationwide ABM system would not be enough. In the absence of additional restrictions—on developing, testing and manufacturing ABM-system components—the Soviet Union could easily produce and stockpile the components for later deployment. Indeed, if the Soviet leadership ever decided to break out of the treaty, the U.S.S.R. could have rapidly established an extensive ABM system. Hence, American negotiators wanted an agreement that prohibited the Soviet Union not only from deploying a nationwide ABM system outright but also from positioning itself to deploy one quickly.

At the same time the American negotiators did not want to restrict ABM research unduly. Many federal government officials wanted the U.S. to continue seeking new and possibly better approaches for defending the nation against nuclear attack. ABM-related research was also needed in order to help the U.S. assess Soviet technology and prepare military responses in the event the Soviet Union ended up deploying a nationwide ABM system. In addition, some ABM technologies were useful for other military purposes. The negotiators therefore had to be careful about where they drew the line separating permitted and prohibited ABM-related activities.

The question of where exactly to draw such a line is once again at the center of Soviet-American arms-control talks; this time it has to do with the development and testing of military technologies that can find potential application in space-based ABM systems. The Reagan Administration, having established the Strategic Defense Initiative (SDI) specifically to intensify the exploration of such technologies, naturally wanted to shift the line toward increased permissiveness. The matter was left unsettled, however. To understand the fundamental conflict that underlies the question, it helps to go back and review the purpose of the original negotiations on limiting ABM systems.

It was clear 20 years ago (as it is today) that no treaty could realistically ban ABM research. For one thing, it is not possible to distinguish between ABM and non-ABM research. For another, it is not possible to verify what goes on inside Soviet laboratories. And besides, the U.S. itself stood to benefit from an active ABM research program of its own. For these reasons American negotiators pressed for limits on the engineering development and testing of ABM components—but not on scientific research—in addition to strict limits on the deployment of ABM systems.

Actually, the development and testing limits had to cover more than just ABM-system components; they had to apply as well to other military systems having a significant degree of technological kinship to ABM systems, such as antisatellite (ASAT) systems and weapon systems for defending against enemy aircraft and short-range battlefield missiles. Modified versions of such systems can have potential application in an ABM defense. Similar concerns held for radars and other key sensors in systems that provide warning of missile attacks, track objects in space, monitor weapon test ranges and collect intelligence. In the absence of limits that apply to the development and testing of such technologies, the Soviets could surreptitiously acquire an ABM capability in the guise of pursuing some other military mission and thereby "leak out," rather than break out, of the treaty regime.

The final product of the negotiations—the 1972 ABM Treaty—explicitly recognizes both the breakout and leakout problems. Article I of the treaty obliges each side not only to refrain from deploying a nationwide ABM defense but also "not to provide a base for such a defense." Article VI forbids giving non-ABM systems "capabilities to counter strategic ballistic missiles or their elements in flight trajectory" and forbids testing them "in an ABM mode." Such general legal prohibi-

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tions, however, can be implemented only after they have been translated into specific technical rules.

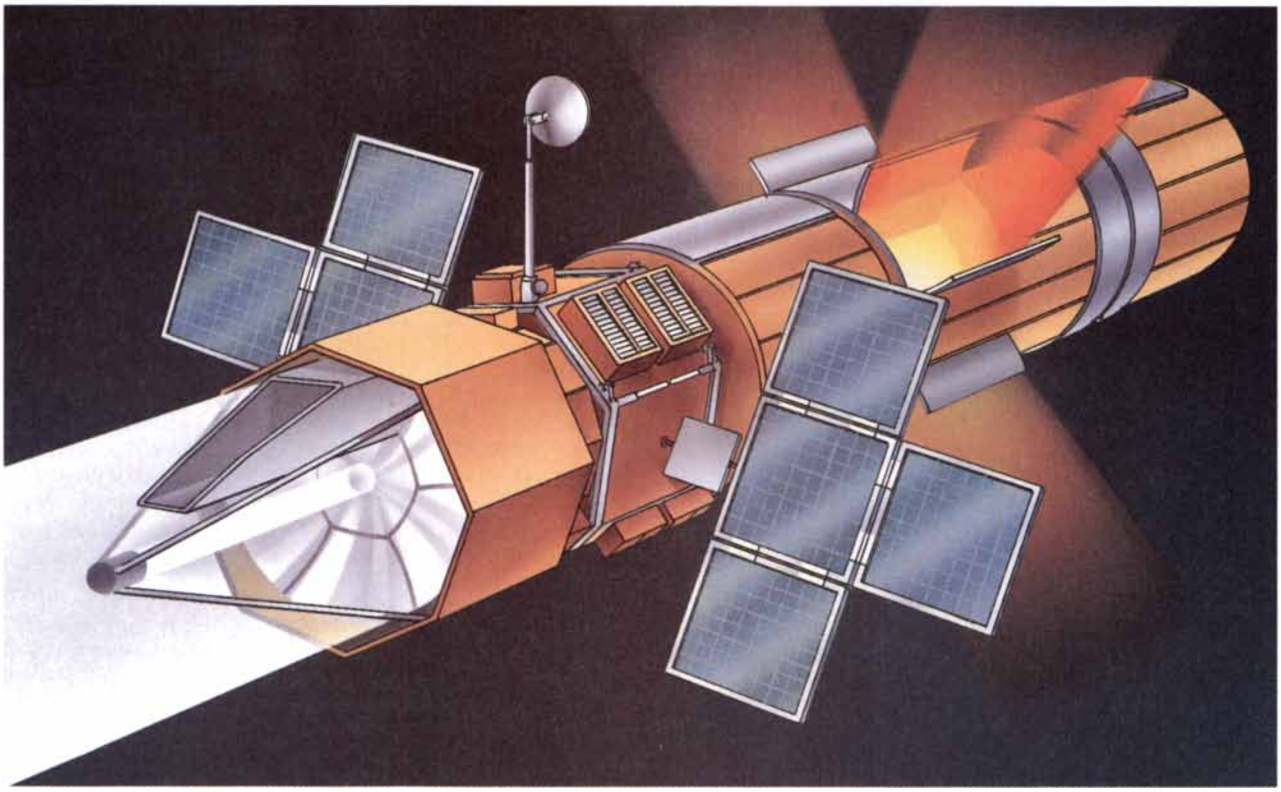
The 1972 treaty (which is still in force) does supply some technical specifics, but most of them apply to the ABM technologies of that era, which consisted primarily of ground-based radars for tracking reentry vehicles and ground-based nuclear-tipped interceptor missiles for destroying them. The negotiators of the treaty were well aware that ground-based radars and interceptors were not the only technologies of potential relevance to an ABM defense. Space-based lasers, particle-beam generators, infrared sensors and most of the advanced technologies currently under intensive study in the SDI program had already been proposed for ABM missions by 1972—and in most cases a good deal earlier. Yet the negotiators believed that detailed questions of interpretation pertaining to such technologies could best be answered if and when they advanced to the point where either side grew concerned about the other's breakout or leakout from the treaty.

The U.S. has not only sought to constrain Soviet breakout and leakout potential in the formulation of technical rules; it has also sought to give its own ABM program enough leeway to collect the data needed to determine whether the U.S. ought to continue abiding by the treaty or deploy an ABM defense. Because one set of rules—applying equally to the U.S. and the U.S.S.R.—must balance the threat of a rapid deployment of an ABM system against the need to explore ABM-related concepts, the two objectives can occasionally come into conflict.

Indeed, such a conflict has arisen in connection with the development and testing of space-based weapon systems. Officials in the Reagan Administration, fearing that the formulation of a new set of interpretative rules could effectively kill the SDI program, refused to enter into technical discussions with the Soviets. Instead they aggressively advocated a "broad interpretation" of the treaty that allowed unrestricted testing of advanced ABM components in space. Soviet officials, for their part, argued that the research of space-based ABM systems should be limited along with their development and testing—a position that is also inconsistent with the original ABM Treaty. President Bush now has to grapple with the issue his predecessor left unresolved.

Resolution of this issue is essential to the continued viability of the ABM Treaty. Designers of ASAT systems and space-based sensors, both in the U.S. and the U.S.S.R., need to know how the treaty's limits apply to their work. Analysts monitoring compliance with the treaty need to know how to recognize a violation. And Congress and the U.S. public need to be reassured that the treaty is being heeded responsibly.

Clarification of the ABM Treaty's limits on advanced military technologies could be pursued during the coming years in formal arms-control negotiations between the U.S. and the U.S.S.R. Yet formal agreements are not necessary: the SDI Organization and its executive- and legislative-branch overseers could instead state informally which types of space experiments they view as permitted and which as prohibited—in effect setting an example for the Soviets to emulate. As long as both sides are satisfied that the other is following a reasonable interpretation of the ABM Treaty, the issue



ZENITH STAR LASER TEST, planned for the mid-1990's as part of the U.S. Strategic Defense Initiative (SDI) program, is meant to evaluate the weapon potential of space-based chemical lasers. In the test an orbiting hydrogen fluoride laser will direct its beam at orbiting targets. Some observers maintain that the Zenith Star test contravenes the 1972 Antiballistic-Missile (ABM) Treaty, which explicitly forbids tests of ABM-system components based in space. The SDI Organization, however, plans to test the laser as an antisatellite (ASAT) weapon, which does not fall directly under the purview of the treaty.

need not stand in the way of other arms-control agreements.

However the clarification of the limits on testing space-based weapons is pursued, it will need to be based on the technical facts and on a sense of the range of alternatives. In spite of its attempt to undermine the traditional interpretation of the ABM Treaty, the Reagan Administration pledged that the U.S. would continue to abide by it. As traditionally interpreted, the ABM Treaty forbids any test of a space-based weapon that entails intercepting a strategic ballistic missile in flight. Such a "full-up" ABM test is illegal whether the weapon is a homing interceptor missile, a high-energy laser, a particle-beam generator or any other type of weapon. The treaty's ban on full-up ABM testing of space-based weapons applies no matter what the technical characteristics of the weapon are: there is no threshold of weapon "strength" below which such tests would be permitted. ABM weapons can be legally tested on the ground, but such testing has to be carried out at a designated ABM test range. In many cases ground-based testing is fully adequate to obtain the technical data necessary to determine a space-based weapon's feasibility.

Nevertheless, the traditional interpretation has loopholes that allow tests of space weapons to be conducted in such a way that many of the technical features of an illegal full-up ABM test can be replicated. In a "lofted mode" test, for example, the weapon that intercepts the ballistic-missile target is not placed in a stable orbit around the earth. Instead it is boosted into a suborbital trajectory so that it can spend a few minutes in space while the test is conducted and then reenter the atmosphere. Although the weapon is in space only briefly, its position and velocity in relation to the target can be nearly the same as in a full-up test.

In fact, the U.S. has announced plans to test ABM interceptor missiles in a lofted mode. Officials of the SDI Organization argue that if the weapon is carried into space by a booster launched from a designated ABM test range it should be considered ground-based and not space-based—even though it is being designed as part of a system to be deployed in space. Because tests of ground-based ABM systems are allowed (even under the traditional interpretation of the treaty), the U.S. can maintain that its planned interceptor test will not contravene the testing limits of the treaty. Yet if this loophole in the treaty remains open, a space-based interceptor can be legally tested in the lofted mode until it has achieved full ABM capability.

Interceptor missiles can readily be tested in the lofted mode, but powerful chemically pumped lasers (which have been proposed as space-based weapons) are too unwieldy and expensive to be boosted into short-lived suborbital trajectories. Still, another loophole in the traditional interpretation of the ABM Treaty can be exploited to test such a laser in space without violating the letter of the treaty. Although the traditional interpretation bans the testing of ABM systems in space, it does not ban the testing of ASAT systems in space.

It is therefore perfectly legal to perform weapon tests in an "ASAT mode," in which an orbiting weapon intercepts an orbiting target. The Soviet Union has tested interceptor spacecraft in that mode for well over a decade, and the U.S. intends to conduct an ASAT-mode test of a large hydrogen fluoride laser weapon in the mid-1990's under the code name Zenith Star. An ASAT-mode test can easily be made to simulate an ABM-mode test by having the target "satellite" fire a rocket thruster during the test so that it mimics a strategic ballistic missile in the boost or post-boost phase.

Weapon tests in the ASAT mode, unlike those in the lofted mode, are limited to a certain extent by the ABM Treaty. The provision against leakout contained in Article VI of the treaty sets an implicit threshold above which ASAT-mode testing would be illegal, because it prohibits endowing non-ABM weapons such as ASAT systems with an ABM capability. The Zenith Star space laser may or may not exceed that threshold: it all depends on what constitutes "an ABM capability."

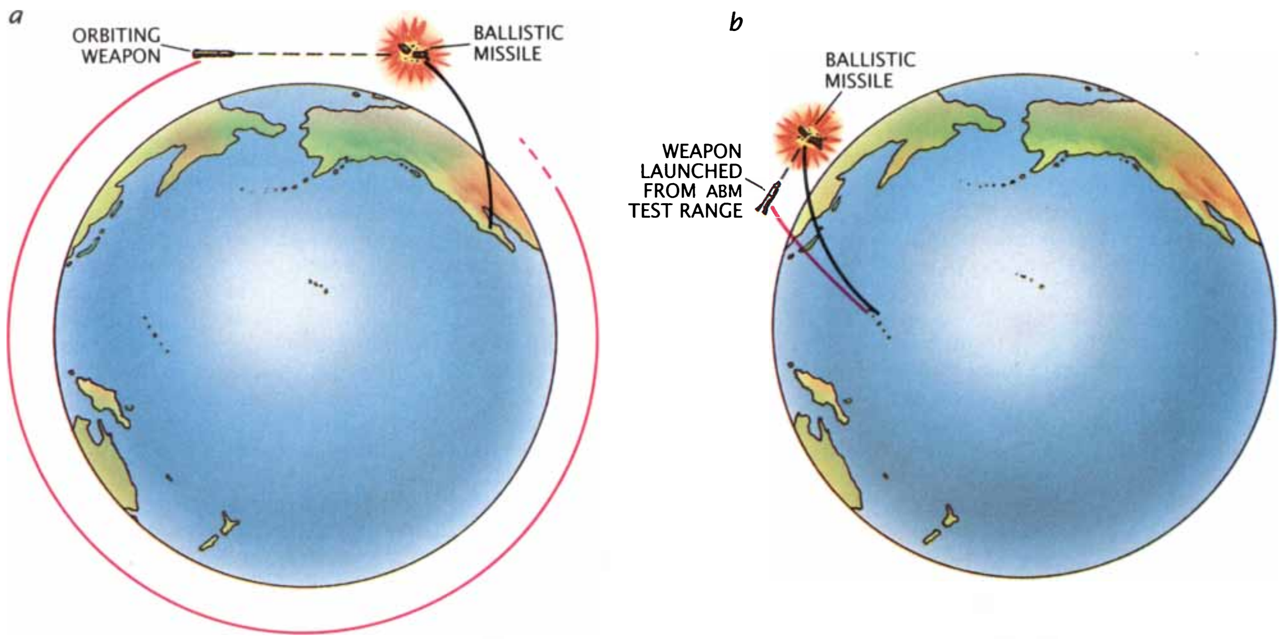
It is not difficult to imagine how thresholds might in principle be defined for lasers, rocket interceptors and particle-beam generators that are tested in space for nominal ASAT or air-defense systems but that are potentially applicable in ABM systems as well. For example, the rate at which a space-based laser weapon can destroy targets at a given range—and hence its inherent ABM capability—is determined in large part by its brightness: the power of the light emitted by the laser divided by the angular size of the diverging cone into which the laser's pointing mirror can focus the beam. An upper limit on the brightness of lasers in space might therefore serve as a viable constraint on the ABM capability of such weapons.

The American Physical Society's Study Group on the Science and Technology of Directed Energy Weapons suggested that even a missile booster "hardened" to withstand laser illumination would suffer relatively rapid structural damage if it were exposed to an incident energy flux in excess of 300 kilowatts per square centimeter. At a typical ABM interception range of 2,000 kilometers, delivery of such a flux requires a laser having a brightness greater than about 10^{22} watts per steradian. Brightnesses of such magnitude are unlikely to be achieved soon; to date the most powerful chemical lasers (which are ground-based) are reported to have a brightness of some 10^{17} watts per steradian.

Certainly if the U.S.S.R. were someday to test lasers of 10^{22} watts per steradian brightness in space, the U.S. would have to worry about the Soviets attaining an ABM capability through breakout or leakout—even if they maintained that the lasers were designed for ASAT systems. Actually, American defense analysts would be concerned if the Soviet Union put lasers having a good deal less brightness in space: the current U.S. strategic nuclear forces, consisting of Minuteman and MX/Peacekeeper intercontinental ballistic missiles (ICBM's) as well as Poseidon and Trident submarine-launched ballistic missiles (SLBM's), are not hardened against laser damage. In addition, a Soviet space-based laser might come within less than 2,000 kilometers of a U.S. missile in some scenarios of potential military concern. Hence, the brightness threshold for concern is closer to 10^{17} than to 10^{22} watts per steradian. Presumably Soviet calculations would lead them to the same conclusion about U.S. lasers in space. Thresholds of ABM capability for other types of weapons can be similarly defined.

Although single-parameter thresholds may be technically elegant and intuitively appealing, in practice they are problematic. The ABM potential of a space-based laser depends not only on its brightness but also on its wavelength, on the supply of laser-pumping energy on board its space platform and on other factors. Moreover, the acquisition, pointing and tracking systems that direct the laser beam to targets are themselves characterized by an array of physical parameters that directly affect a space-based laser's ABM capability.

Another major difficulty in negotiating weapon thresholds is their verifi-



FOUR MODES of testing a space weapon are treated differently by the ABM Treaty, in spite of the fact that they can—to a certain extent—be made to replicate the same test conditions. In a "full-up mode" ABM test (*a*) a weapon in stable orbit intercepts a strategic ballistic missile in flight. In a "lofted mode" test (*b*) the intercepting weapon is launched on a suborbital flight; it is technically not "based" in space. In an ASAT-mode test (*c*) both weapon and target are placed in orbit. In an air-

cation. Each party to the ABM Treaty should be able to assure itself that the other party is complying with the agreement. If brightness thresholds are to be the basis for judging treaty compliance for space-based lasers, each side must have some method of measuring the brightness of the other's test lasers in space.

The U.S. and the U.S.S.R. could deploy a constellation of satellites capable of detecting laser beams, but it would be unlikely for one side's satellites to be in line with the beam of the other side's space laser at the time it was tested. Intelligence sensors would instead have to collect laser energy scattered by the focusing mirror, space junk, the test target or the earth's atmosphere. Further information might come from other types of sensors capable of detecting the combustion products of the chemically pumped lasers (which are released into space) or the electromagnetic emanations of electrically pumped lasers. The physical size of a space-based laser's optics (which determines the solid angle of its beam) could be measured from the ground or from space by making images of the laser assembly while it is illuminated by sunlight, another laser's light or radar.

Although all of these verification methods are technically feasible, none is foolproof and all are expensive. It has taken the U.S. several decades and many billions of dollars to acquire all the sensors it currently employs to monitor Soviet ABM systems and offensive-missile forces. Comparable amounts of time and money might be necessary for verifying the Soviet Union's adherence to new threshold-based rules for the ABM Treaty.

Yet another weakness of thresholds in setting treaty-compliance rules is that a space weapon might be tested below the threshold and yet be modified to achieve a greater capability. If such upgrading turns out to be relatively easy, then threshold-based limitations provide an insufficient "buffer" period in which to respond to a rapid breakout or leakout: the only buffer left is the time-consuming process of deployment itself.

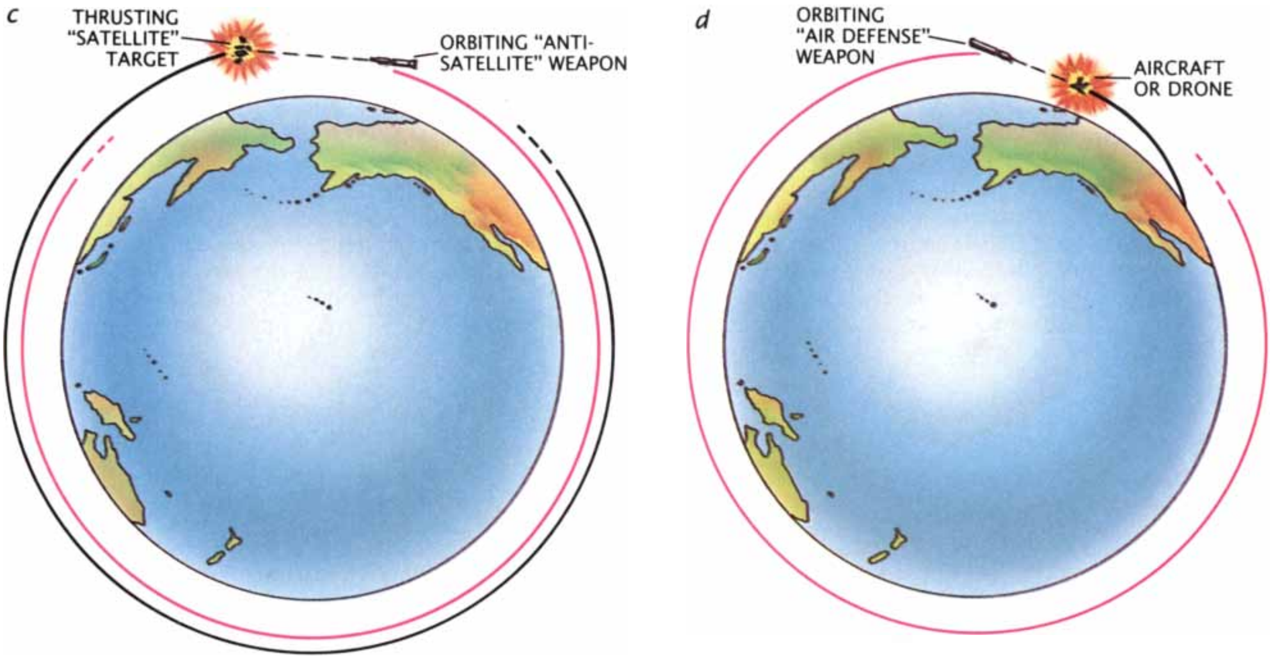
As traditionally interpreted by the U.S., then, the ABM Treaty prohibits full-up ABM tests of space weapons entirely, does not restrict lofted-mode testing and permits ASAT and air-defense testing up to a currently undefined threshold. Clearly, one key task for the U.S. and Soviet technical specialists discussing the treaty's testing rules should be to define some threshold for ASAT and air-defense testing.

A more important task would be to determine whether ASAT-mode test interceptions of targets equipped with rocket thrusters should be permitted at all. Ordinary satellites, which would be the intended targets of a true ASAT weapon system, fire their thrusters only intermittently and at low thrust levels. Banning ASAT-mode test interceptions of thrusting targets would therefore constrain the development only of ABM systems, not ASAT systems. (Of course the two superpowers might want to limit the development of ASAT weapons, but that would require a new treaty.)

Also, consideration should be given to closing the lofted-mode loophole entirely. The testing of ABM systems at designated test ranges, as allowed by the ABM Treaty, was intended to permit testing of ground-based components only. Yet ABM-capable weapons that are tested in the lofted mode are generally intended for deployment in a space-based, not a ground-based, configuration.

Finally, any agreement clarifying the ABM Treaty's strictures should also include measures that make it easier to verify that both sides are in fact adhering to the agreed limits. In general it is preferable to frame the limits embodied in an arms-control treaty in terms of testing practices rather than numerical thresholds of a weapon's capability, because testing practices are more easily verified.

Rather than simply clarifying and updating the traditional interpretation of the ABM Treaty, U.S. and Soviet negotiators could decide to replace it with new agreements. Such


c
THRUSTING "SATELLITE" TARGET
ORBITING "ANTI-SATELLITE" WEAPON
d
ORBITING "AIR DEFENSE" WEAPON
AIRCRAFT OR DRONE

defense-mode test (*d*) the weapon is aimed at an aircraft in flight or an instrumented target on the ground. The traditional reading of the ABM Treaty forbids the testing of any type of weapon in a full-up mode but does not restrict lofted-mode tests if the weapon is launched from an agreed ABM test range. Weapon testing in space in the ASAT and air-defense modes are also allowed, as long as they do not exceed an unspecified threshold beyond which they are regarded as "ABM capable."

agreements could be either more restrictive or more permissive than the 1972 treaty. In either case, the negotiators would still have to balance the two fundamental goals of the original treaty: to preserve a buffer against the rapid breakout or leakout of an extensive ABM system while allowing the exploration of new technology for ABM defense and other related military missions.

A more restrictive approach might begin with the banning of ASAT-mode weapon tests in space entirely—even against nonthrusting targets. Such an agreement would curtail the development and deployment of space-based ASAT systems as well as space-based ABM systems. (Ground-based ASAT systems and space mines would presumably be still allowed.) It would also obviate the need to define thresholds and thereby ease verification.

Even if the superpowers are unwilling to ban all tests of space weapons, they might at least agree to new and intrusive means of verifying compliance with existing restrictions as contained in the ABM Treaty. In the case of space weapons, an agreement to facilitate verification might require the announcement and description of space tests before they actually take place and even the prelaunch inspection of one another's test payloads.

Another alternative would be to ban nuclear reactors in space. Such a ban would greatly impede the development of many types of space-based beam weapons, because there are no ready alternative sources of energy for the large amounts of power such weapons require. Civilian planetary space probes and low-power nonreactor nuclear-energy sources would be exempt, although they might be subjected to inspection before launch to ensure that they could not serve as part of a weapon system.

At the other extreme, a much more permissive approach to development and testing of weapons in space might be entirely consistent with the ABM Treaty's original purpose. This would be the case if it could be shown that the time required for final deployment provides an adequate buffer against rapid attainment of a space-based ABM capability. In other words, deploying an effective ABM system in space may ultimately require so much time as to make breakout impossible, even if the system's components have already been developed and tested.

In fact, the ABM Treaty embodies such a view with regard to the development and testing of fixed ground-based ABM systems. Tests of such systems are not heavily restricted (as long as they are carried out at agreed test ranges), apparently because treaty negotiators believed the deployment of an effective ground-based ABM system would be so conspicuous and time-consuming that if one side broke out of the treaty and began to deploy such a system the other side would have ample time to respond.

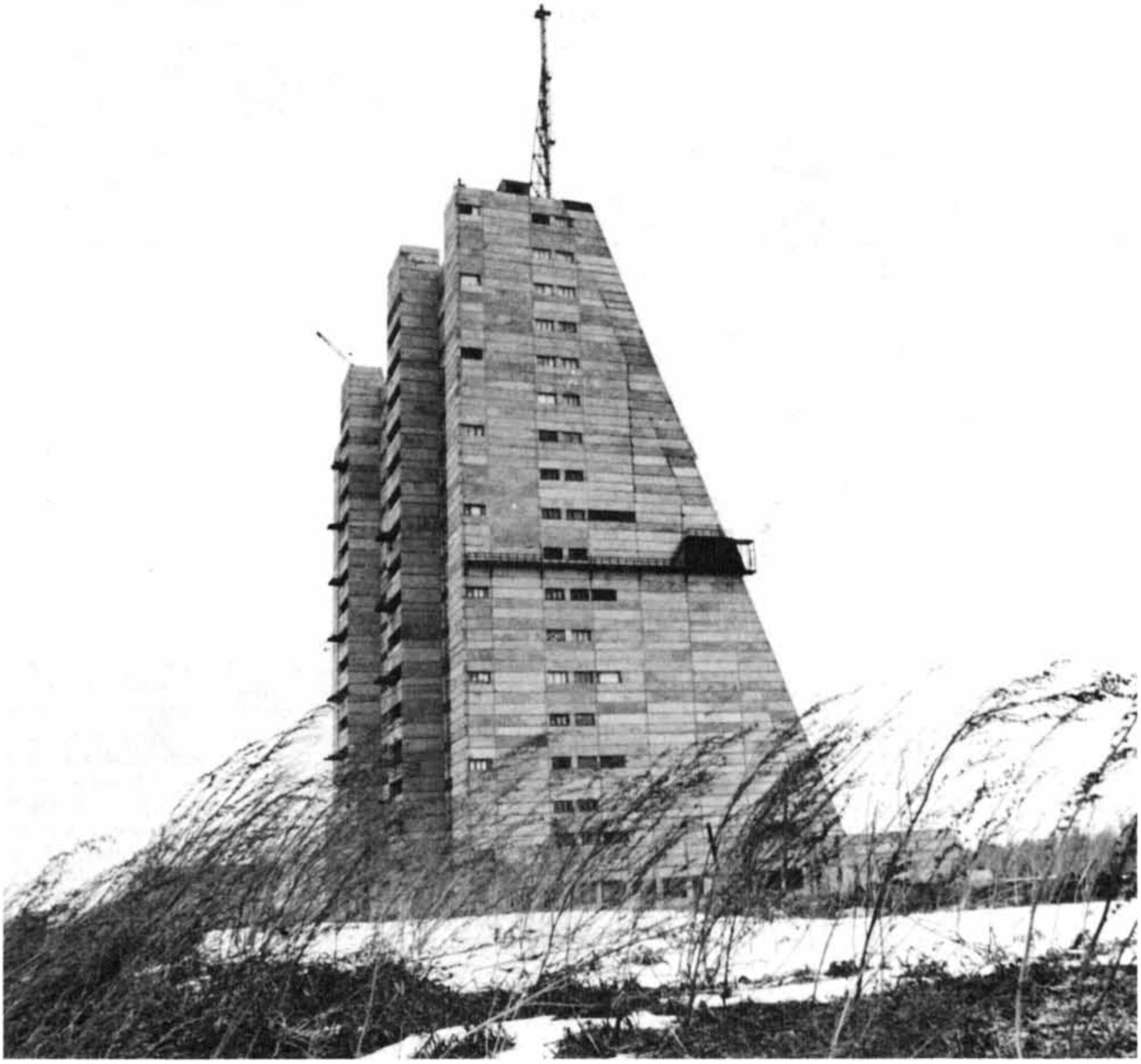
Can a case be made that comparable freedom to develop and test space-based ABM systems would also preserve an adequate buffer against breakout and thereby remain consistent with the ABM Treaty's main purpose? If so, then an agreement that permits extensive space testing while maintaining an absolute ban on deployment could be justified without recourse to the dubious legalistic reasoning of the Reagan Administration's broad interpretation of the ABM Treaty.

Under such an agreement, each side could be allowed to establish an agreed orbital test range where it could perform tests of space weapons in the full-up ABM mode. There are many ways such a test range could be defined, but the simplest would be for each side to specify the parameters defining a particular orbit: altitude, inclination, longitude and time of ascending node. The orbital test range could consist of a single space structure placed in the specified orbit. All test weapons would then have to be docked with the structure. A more practical scheme would merely require that all weapons involved in ABM tests be clustered together, say, within a spherical volume having a 50-kilometer radius in the specified orbit.

Because the open purpose of such

an orbital test range would be to serve as a setting for realistic testing of ABM-system components, the range should be situated at the altitude where the components would probably be deployed, some 500 to 700 kilometers above the earth. Its orbit would be inclined so that it passed over each side's ICBM and SLBM test ranges and ground-based ABM test ranges. The number of weapons allowed at the orbital test range would be limited, however, so that the range did not itself pose an ABM threat to the other side. All test interceptions in the full-up ABM mode would have to be performed from the range, and no weapon tested at the range could ever be deployed anywhere else. Each side could then station intelligence satellites near the other side's orbital test range to reassure itself that the range posed no breakout threat.

There is little in such an arms-control agreement to hinder the full development and testing of components of a space-based ABM system—by either side. Viewed from the perspective of U.S. negotiators, then, such an agreement would be in the country's national security interest only if it would take a long time for the Soviets to deploy an ABM defense after breaking out of the agreement. During that time the U.S. could beef up its own deterrent forces, deploy ASAT weap-



RADAR AT KRASNOYARSK, rising from its site in the U.S.S.R.'s interior, stands in violation of the ABM Treaty, which requires that all such radars be situated on the country's periphery and face outward. That requirement was intended to make it difficult for either the U.S. or the U.S.S.R. to "break out" or "leak out" of the treaty. In this context, breakout is the rapid deployment of a nationwide ABM system by one side after it has decided to abrogate the treaty; leakout is the surreptitious upgrading of legal ASAT, air-defense or missile-warning systems so that they acquire an illegal ABM capability. Similar breakout and leakout constraints will need to be imposed on future ABM technology in order to maintain the integrity of the treaty.

ons to shoot down the defense system's satellites, build its own ABM defense or enact other countermeasures to nullify the Soviet defense.

Just how quickly could the Soviet Union deploy a space-based ABM system once it had decided to break out of the agreement? The Soviet Union's capacity to launch payloads into orbit establishes a lower limit on the time required for deployment. Unfortunately, this minimum time could be quite short, at least for a first-generation defense of limited capability.

A study by the congressional Office of Technology Assessment supplies a reasonable, if indirectly applicable, standard by which to measure the Soviet Union's breakout potential. The study estimates that the deployment of the first-generation "Phase I" system favored by the U.S. SDI Organization would entail launching payloads with a total mass of between one and two million kilograms into an inclined, low earth orbit. Yet the U.S. Department of Defense predicts that the Soviet Union will be capable of placing one million kilograms per year into low earth orbit by the early 1990's and almost two million kilograms per year by the turn of the century. Almost all of this lift capacity is accounted for by the new Energia launcher, which has an estimated payload of as much as 100,000 kilograms.

If the Soviets were able to launch Energia boosters at the rate foreseen by the Defense Department and if they freely developed and tested components of a space-based ABM defense, then clearly the U.S. would be guaranteed no more than a few years of buffer time against a Soviet breakout deployment of a first-generation space-based ABM system similar to the U.S. SDI's Phase I. For the Soviets the buffer against a U.S. breakout would be much longer, since the U.S. does not have a heavy-lift launcher comparable to the Energia.

Unless U.S. government officials have strong reason to believe that the Soviet Union could not in fact deploy a fully developed ABM defense in a short time, there are only three alternatives that could ensure the U.S. a reasonable buffer period against a Soviet ABM breakout. The first is simply to stick to the traditional interpretation of the ABM Treaty, which effectively hinders the Soviet Union from completing development of space-based ABM weapons by banning tests of space-based ABM-system components.

The second possibility is to negotiate limits on launch capacity along with the establishment of agreed or-

CLARIFY THE TRADITIONAL INTERPRETATION OF THE ABM TREATY

Confirm that the testing of any type of space-based weapon system in a full-up ABM mode is forbidden.

Confirm that simulated or attempted interceptions in space are also banned.

Confirm that the same rules apply to the boost-phase interception of both strategic and nonstrategic missiles.

Determine whether lofted-mode weapon tests are permitted or prohibited.

Determine whether ASAT-mode weapon tests against thrusting targets are permitted or prohibited.

Determine the threshold at which weapons tested in the ASAT and air-defense modes are "ABM capable." Confirm that weapons exceeding the threshold are not allowed to be tested in space.

Determine the threshold at which space-based ASAT and air-defense systems attain an ABM capability or create a base for rapidly establishing an ABM defense. Confirm that the deployment of systems exceeding the threshold is banned.

Agree to forbid specified types of interference with verification (telemetry encryption, for example) during tests of space weapons in all allowed modes.

Agree to require that tests of space weapons in all allowed modes be carried out from or along customary ICBM and SLBM test ranges and agreed ABM test ranges or from space weapons passing over those ranges.

NEGOTIATE A MORE RESTRICTIVE REGIME

Agree to most or all of the points listed above.

Agree to forbid all lofted-mode weapon tests.

Agree to forbid all ASAT-mode weapon tests against thrusting (and perhaps even nonthrusting) targets.

Agree to forbid all air-defense-mode tests.

Agree to announce and describe tests of space weapons before they actually take place.

Agree to allow prelaunch inspection of specified payloads connected with tests of space weapons.

Agree to ban nuclear reactors in space except those on civilian spacecraft, which would be subject to prelaunch inspection.

NEGOTIATE A MORE PERMISSIVE REGIME

Define orbital test ranges at which each country can carry out its tests of space weapons.

Agree on the number and types of space weapons that can be tested at an orbital test range.

Determine which types of tests are prohibited in space except at an orbital test range.

Agree to certain measures that facilitate monitoring of activities at an orbital test range.

Agree that all test targets are to be launched along customary ICBM and SLBM test ranges or agreed ABM test ranges.

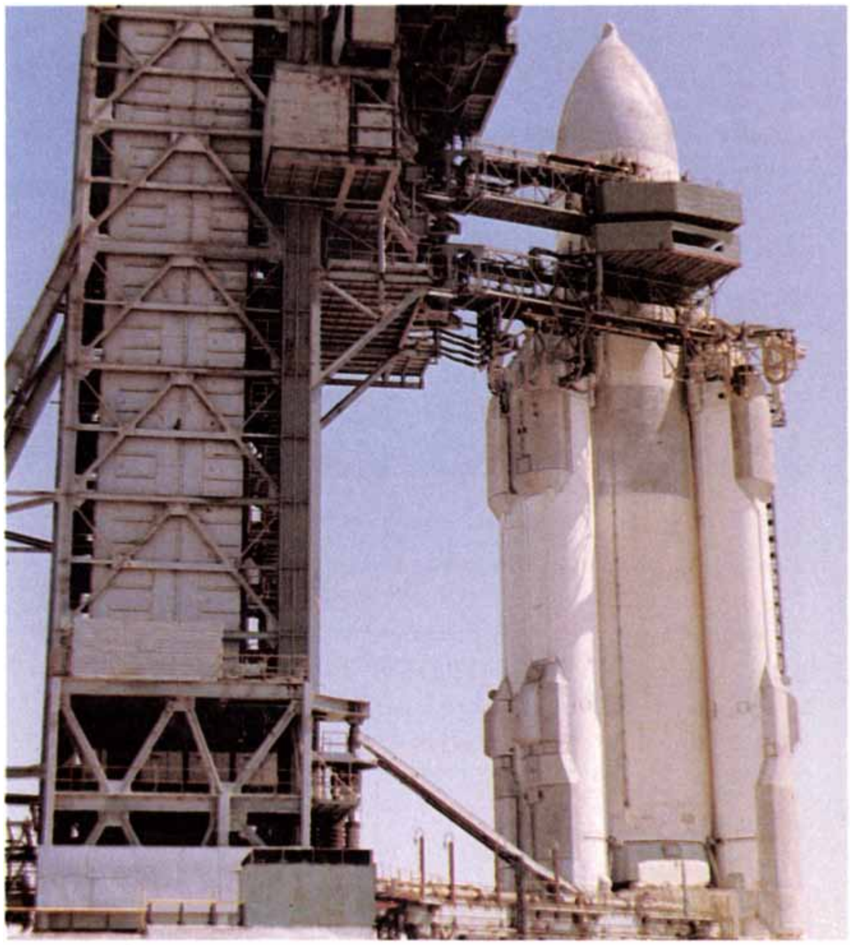
Agree to forbid tests of components of deployed space-based ASAT or air-defense systems in a full-up ABM mode.

Determine the threshold at which space-based ASAT and air-defense systems attain an ABM capability or create a base for rapidly establishing an ABM defense. Agree to ban deployment of systems exceeding the threshold.

Agree to limit heavy-lift launch capability in order to preclude the rapid deployment of a space-based ABM system.

Prepare unilateral countermeasures as needed to ensure effectiveness of offensive-missile force, given the increased risk of breakout and leakout associated with a permissive weapon-testing regime.

THREE APPROACHES to negotiating an agreement to limit the testing of ABM-related weapons in space differ in the strictness of the limits. The goal is to craft mutually acceptable restrictions that allow a reasonable amount of research and testing of ABM concepts while ensuring to each side a "buffer" period long enough to enact effective countermeasures if the other side breaks out or leaks out of the agreement.



ENERGIA LAUNCHER affects the ABM Treaty's capacity to hinder a Soviet breakout. It is thought that a single Energia launcher can place 100,000 kilograms into low earth orbit. (The U.S.'s most capable launcher—the space shuttle—has a maximum payload of about 25,000 kilograms.) Given that capability, a first-generation space-based ABM system could in theory be deployed by the U.S.S.R. fairly rapidly.

bital test ranges. These limits might focus on the number of launch pads for heavy-lift boosters; the size of launcher-assembly buildings connected to the pads by rail or heavy-duty road; the capability for manufacturing and transporting the enormous rocket stages of a heavy-lift launcher; and the number and size of facilities for producing, transporting and storing liquid-hydrogen fuel.

The third alternative is to compensate for the eroding buffer by deploying (or making preparations to deploy) countermeasures to possible Soviet ABM systems. The U.S., for example, could build more offensive missiles or abandon certain targeting plans that critically rely on the unimpeded passage of nuclear missiles.

In spite of the open loopholes, the undefined thresholds and the dubious interpretations, the U.S. and the U.S.S.R. will probably continue to find it in their national security interest to keep the ABM Treaty regime intact. The reason is simply that neither side currently knows how to build missile defenses that are technically and militarily attractive. Nevertheless, the ABM Treaty's rules on the development and testing of military technology do require periodic revision as the technology changes. It seems likely that such updating, in particular with regard to space weapons, will figure prominently in superpower arms-control negotiations in the coming years.

In discussions of such technical rules and definitions it is important to recognize that there is considerable latitude for drawing the line between permitted and prohibited ABM-related activities. On the one hand, development and deployment of a space-based ABM system relying on current technology would be an inherently conspicuous and time-consuming process. Neither side need worry that the other could break out of the treaty regime and quickly deploy a system that is more than a nuisance. It can be reasonably argued on those grounds that the rules governing the development and testing of space weapons can safely be made fairly permissive.

On the other hand, all of the crucial technical work bearing on the feasibility of advanced ABM concepts can be accomplished for the time being without extensive space testing, within the traditional interpretation of the 1972 ABM Treaty. (Indeed, elaborate space tests of exploratory technology can be a waste of money.) For that reason it can also be reasonably argued that the rules might as well be made fairly restrictive.

There is also no particular urgency to the discussions, since few advanced ABM technologies are truly approaching significant military capability today. Although many technologies will be explored by the U.S. as part of the SDI program, few—if any—of the concepts on today's SDI briefing charts will survive to the stage of serious preprototype development. Comprehensive and precise technical rules covering all types of lasers, particle-beam generators, interceptors and sensors will not be necessary soon.

Nevertheless, a consensus between the U.S. and the U.S.S.R. to pursue seriously the updating of the ABM Treaty would demonstrate that the superpowers understand the technical and military basis of this important arms-control agreement, and it might even help in their negotiations to reduce offensive nuclear weapons. It is probably more important to clarify the line between permitted and prohibited ABM-related activities than to draw it at a certain place.

FURTHER READING

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—Einstein

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